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Original Article

# The use of TeleMedicine in the treatment of paediatric obesity: feasibility and acceptability

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**Abstract**

To assess the feasibility of conducting empirically supported family-based paediatric obesity group treatment via TeleMedicine. Seventeen families were randomly assigned to one of two conditions (physician visit, TeleMedicine). Measures included feasibility, satisfaction and intervention outcome measures such as BMI percentile, and nutrition and activity behaviours. Measures were completed at baseline, post-treatment and at 1-year follow-up. Analyses indicate that both feasibility and satisfaction data regarding the TeleMedicine intervention were positive. Intervention outcome indicates no change in BMI percentile or nutrition and activity behaviours for either treatment group. A behavioural family-based weight loss intervention delivered via TeleMedicine was well received by both parents and providers. Due to the small sample size, null findings regarding intervention outcome should be interpreted with caution. Future research should focus on methods to increase the impact of this intervention on key outcome variables.

*Keywords:* TeleMedicine, paediatric obesity, intervention, feasibility.

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## Introduction

The prevalence of overweight and obesity among children in the United States has increased rapidly over the past several years (Strauss & Pollack 2001) to the point that it is now termed a public health epidemic (Strauss 2002). Recent data indicate that 10–25% of children under the age of 18 are overweight or obese (Troiano *et al*. 1995). Children who are overweight or obese are likely to maintain their weight status and become obese adults (Stark *et al*. 1981; Whitaker 1997). However, even if they lose weight and become adults of normal weight status, these individuals are likely to have significant health concerns in adulthood secondary to their childhood weight status including heart disease, lipid abnormalities, hypertension, diabetes mellitus, sleep apnea, infertility, gall bladder disease and some cancers (Dietz 1998; Must & Strauss 1999). Overweight and obese children also have poorer levels of academic achievement (Taras & Potts-Datema 2005). significant problem for both males and females (Ogden *et al*. 1997).

Treatments for paediatric overweight [body mass index (BMI) ≥85th percentile and for age and gender; Barlow & the Expert Committee 2007] and obesity (BMI ≥95th percentile for age and gender) include primarily family-based behavioural programmes (Epstein *et al*. 2007), medication (Moyers

2005) and surgery (Velhote *et al*. 2007). For the vast majority of patients, the optimal treatment is a family-based behavioural programme (Barlow & the Expert Committee 2007). These programmes typically include a nutrition component, an exercise/activity component and a behavioural component. They are ideally delivered to the entire family and focus on life long changes for the family rather than short-term answers for a single individual.

In order to combat the paediatric obesity epidemic, novel technologies are being sought to reach individuals who may have difficulty travelling to a tertiary care centre that provides the family-based behavioural treatments described above. One such novel technology is TeleMedicine. TeleMedicine is a form of interactive televideo allowing individuals at one site to communicate with individuals at a second site in real time using both voice and picture features. This type of interactive televideo is often available in rural school settings and is used for off-site teaching of specialized topics that may not be available in every small town, both for students and for professional development for teachers. Previous research indicates that TeleMedicine is useful for services ranging from cardiac auscultation (Mattioli *et al*. 1992) to psychiatry services (Modai *et al*. 2006). TeleMedicine has also been used to conduct focus groups to gain provider opinions on topics including paediatric TelePsychiatry (Greenberg *et al*. 2006) and student opinions on distance learning (Cartwright & Menkens 2002). These studies suggest that both clinical care and qualitative research can be successfully conducted over TeleMedicine. Specific to paediatrics, a recent review titled 'Telepaediatrics' reports that TeleMedicine has been well established as a useful clinical tool in paediatric cardiology, fetal medicine, school health and psychiatry (Smith 2007). Studies of TeleMedicine in general have found that although the initial installation costs can be high ($300 assuming an existing Internet connection), the services are billable and the cost savings to patients and providers regarding time and travel are immense (Davalos *et al*. 2009).

Regarding paediatric obesity treatment, much of the existing literature focuses on school based interventions as children spend so much of their time in this setting. As mentioned above, schools also often have interactive televideo services for learning opportunities, especially in rural areas to allow for sharing of resources between sites. Therefore, it is not surprising that previous research has been conducted regarding the use of TeleMedicine to treat paediatric obesity in schools. For example, Hung *et al*. (2008) conducted a study of 37 children in China who participated in a 14 week Weight-loss E-learning Program. Schiel *et al*. (2008) report on the use of TeleMedicine to support weight loss maintenance in their group of 140 obese children post discharge from an inpatient treatment programme in Germany. The only study to be conducted with rural obese children looked at the use of a consultation model (specialist consulting with primary care practitioners) and found that the consultations changed diagnoses (77.8%), and increased testing (79.8%). Of the patients who used the consultation service repeatedly, many improved their diet (80.6%) and their physical activity levels (69.4%; Shaikh *et al*. 2008). The most well validated treatment for paediatric obesity, family-based behavioural groups, have never been tested via

**Key messages**

- Paediatric obesity is one of the key public health issues today for women and children around the world.
- The most well validated treatment for paediatric obesity is family-based behavioural groups conducted on a weekly basis with both parent and child.
- Families who live in rural areas often have a difficult time travelling to family-based behavioural group paediatric obesity treatment programmes.
- TeleMedicine (interactive televideo) is a relatively low-cost method of delivering paediatric obesity treatment groups to rural families.
- Delivering family-based behavioural groups for the treatment of paediatric obesity is not only feasible but families also find it highly satisfactory.

TeleMedicine, either in terms of treatment outcome or in terms of regarding feasibility of delivering these interventions via TeleMedicine or acceptability by the families. Given that the inaugural paediatric telehealth colloquium was held in October 2006 (Parsapour *et al*. 2007), it is likely that the amount of paediatric TeleMedicine research is going to increase in the coming years.

The current study sought to assess the feasibility of conducting empirically supported family-based paediatric obesity group treatment via telemedicine. Primary outcomes for the TeleMedicine intervention include feasibility and satisfaction. Primary outcomes across groups included child BMI percentile, and nutrition and activity behaviours. The current study builds off of the only previous study assessing the feasibility of using TeleMedicine for paediatric obesity intervention (Shaikh *et al*. 2008), in that the current paper uses group treatment, which is more empirically supported, is prospective rather than retrospective, and does include a control group for comparison purposes.

## Materials and method

### Participants

Researchers recruited two urban and two rural schools to the current project from a listserv of all TeleMedicine capable schools throughout the state of Kansas. The first two urban and two rural schools to express interest were accepted. The two urban schools were located in two large, metropolitan areas in Kansas; the two rural schools were located in towns of less than 20 000 in population in Western Kansas. School nurses at these four elementary schools contacted families of 5th grade children who they served to invite them to participate in the current study. The nurses targeted families of children who were overweight or obese (BMI ≥85th percentile for age and gender) and had no major developmental difficulties that would interfere with participation in a group programme. A total of seventeen mother–child pairs were recruited to participate – no parents or children who were asked to participate refused. All children were in the 5th grade and about 10 years old (M = 9.9 years, SD = 0.34). Over half (58.8%) of the children were female. The sample was primarily Caucasian (47.1%) and African American (47.1%) with some Hispanic participants (5.9%). Not surprisingly, most of our maternal participants had a BMI in the obese range (M = 32.0). See Table 1 for additional demographic information.

**Table 1.** Participant demographics

| | |
|---|---|
| Number of participants | 17 |
| Age Mean (SD) | 9.85 (0.34) |
| Gender (% female) | 58.8 |
| Race (%) | |
| Caucasian | 47.1 |
| African American | 47.1 |
| Hispanic | 5.9 |
| Family income (%) | |
| Not reported | 5.9 |
| 0–29 999 | 41.2 |
| 30 000–49 999 | 41.2 |
| 50 000 or above | 11.7 |
| Maternal Years of Education (%) | |
| Partial High School-High School | 23.5 |
| Voc/Assoc Degree or Partial College | 53.0 |
| 4-year College or Graduate Degree | 23.5 |

### Statistical analyses

The data were analyzed using the statistical package SPSS (Version 16.0; SPSS, Inc. Chicago, Illinois, USA). Means and SDs were calculated for all continuous variables. Percentages were calculated for all categorical demographic variables. Analyses were conducted comparing TeleMedicine intervention and physician visit groups on demographics and baseline measures to determine the success of randomization. Then, 2 (group) × 2 (time) repeated measures analyses of variance (ANOVAs) with Greenhouse-Geiser correction were used to assess the differential effectiveness of the TeleMedicine intervention vs. the physician visit on BMI, dietary intake and physical activity outcome measures. The 1-year follow-up effects were assessed using 2 (group) × 3 (time) repeated-measures ANOVAs with Greenhouse-Geiser correction.

### Procedure

Prior to the start of the investigation, school nurses were trained in study procedures, including proper

**Table 2.** Behavioural intervention topics covered during each session

| Meeting number | Topic | | |
|---|---|---|---|
| | Nutritional | Exercise | Behavioural |
| 1 | The Research on Breakfast | Planned Exercise Activities – Working out Individually and as Family | The Importance of Tracking and Using Sticker Charts |
| 2 | How to eat a Healthy Lunch at School | Incidental Exercise – Burning Calories from Every Day Activity | Differential Attention & How Parents Should Appropriately Use Rewards, and How to Tell if They're Working |
| 3 | Eating Dinner as a Family and Keeping it Healthy | Family Exercise – How to Fit it Into Your Schedule | Mealtime Rules – Do you Have Any? Should You Have More? |
| 4 | Snack & Meals Away From Home | Individual Exercise – How to Get Your Kids Involved | Privileges, Shaping and Review – The Final Behavioural Points |

administration of a dietary recall and calibrating a scale and stadiometer. Institutional Review Board approval was obtained, and signed consent/assent forms were returned to research personnel via school personnel. Measures were then sent home for parents and children to complete together (demographic questionnaire, 7-day physical activity recall). These measures were returned approximately 1 week later, at which time the child met with the school nurse to complete the remaining measures (24-h dietary recall, height, weight). Families were then randomly assigned to one of two conditions: TeleMedicine or Physician Visit. Visits were scheduled by the school nurse as part of her existing duties and were conducted via a 384 kb/s over dedicated ISDN using computer-based Polycom videoconferencing systems. All 17 families completed assessment at baseline, and at post-treatment (2 months later) and 14 completed the follow-up assessment (1 year following post-treatment). All dietary data were analyzed using the Nutrition Data System for Research software (version 2005; University of Minnesota, Minneapolis, USA).

### *TeleMedicine intervention*

The TeleMedicine intervention was composed of four 1-h long group sessions delivered over an 8-week period. Parents and children attended each session, along with the school nurse. Groups were led by a PhD level psychologist via TeleMedicine from a tertiary care medical centre. The two parties were linked via a live, interactive videoconference that provided a secure, high-quality consultation. All parties started the session together to review weekly progress; then the school nurse took the children into the next room while the parents met with the psychologist via TeleMedicine. Both groups covered the same topics but the parent group was primarily didactic and conversational and the child group was primarily activity-based. At the end of each meeting, the children returned to the TeleMedicine room and worked with parents and the psychologist to set goals for the upcoming week. See Table 2 for a list of topics by session.

### *Physician visit intervention*

The physician visit intervention was composed of a single visit with the child's primary care physician. To standardize visits and assure the visit took place, a list of topics was sent to each child's physician suggesting what they may want to discuss during the visit. Physicians checked off the topics they discussed with the patient during the visit, signed the form and returned it to researchers in a stamped self-addressed envelope. All physicians covered all topics and returned the form. Also, no children needed referral to a physician, and none requested the available financial support for this visit.

## Measures

### *Feasibility*

Feasibility was assessed via number of sessions that were interrupted due to technological difficulties, and

via provider session notes which included comments regarding feasibility of intervention delivery via TeleMedicine.

#### *Satisfaction*

Participant satisfaction was assessed via parent report to two items on a 10-point scale ('overall satisfaction' and 'satisfaction with components of the intervention'), as well as to the answer to 'was this project helpful?' (yes, no) and via attendance.

#### *Seven-day physical activity recall (PAR)*

The physical activity recall (PAR) is an interview designed to assess total weekly energy expenditure via frequency, intensity and duration of physical activity over the past week and has been found to be a valid and reliable measure of physical activity in previous research (Sallis *et al*. 1993). The PAR allows for the calculation of metabolic equivalent tasks, a common metric of physical activity expenditure (Ainsworth *et al*. 1993), and for the calculation of sedentary activity variables. The PAR was completed by parents and children together at home (Sallis *et al*. 1993).

#### *24-h dietary recall*

Children were interviewed by blinded research personnel regarding their eating habits for the past 24 h using the 24-h dietary recall. The staff were trained in proper administration techniques by an expert dietitian prior to the start of the study, and standardized food models were provided to all schools for use during the recall. Resulting variables included amount of calorie intake per day, per cent of calories from fat, and the vitamin and mineral composition of foods as well as the timing of meals and meal location. This measure has been shown to be a valid and reliable representation of a child's overall diet in previous research (Frank *et al*. 1977).

#### *BMI percentile*

Based upon their height and weight, each child's BMI was calculated using the Metric formula BMI = (weight in kilograms / height in cm / height in cm) $\times$ 10 000. Each BMI was then plotted on the appropriate gender chart with age, allowing the computation of each child's BMI percentile. As recommended by the new Expert Committee Guidelines (Barlow & the Expert Committee 2007), children at or above the 85th percentile were considered 'overweight' and children at or above the 95th percentile were considered 'obese'. In addition to being recommended as the primary measure of child weight status by the Center for Disease Control and the American Academy of Pediatrics, BMI percentile was chosen as our measure of child weight status as current research indicates it may be the best variable for measuring adiposity change in growing children (Cole *et al*. 2005).

#### *Height*

All schools were provided with a Nasco Mechanical Stadiometer, Model SB32644G (Fort Atkinson, Wisconsin, USA), with built-in levelling bubble and locking headpiece to measure height throughout the study. These stadiometers were checked for accuracy by the nurses on a monthly basis throughout the study and calibrated if necessary. The staff were trained in proper use of a stadiometer prior to data collection, and all heights were taken in triplicate.

#### *Weight*

All schools were provided with a Nasco 400# capacity Digital Column Scale (Fort Atkinson, Wisconsin, USA) to measure weight throughout the study. These scales were checked for accuracy on a monthly basis throughout the study and calibrated if necessary. The staff were trained in proper use of a digital scale prior to data collection, and all weights were taken in triplicate.

## Results

### Feasibility and satisfaction of TeleMedicine

The provider at the tertiary care centre reported that working via TeleMedicine was 'optimal' as they

**Table 3.** Child BMI percentile, nutrition and activity behaviours at pre and post ($n = 17$)

| Mean (SD) | Pre | Post | *P*-value |
|---|---|---|---|
| BMI Percentile | | | 0.567 |
| TeleMedicine Group | 95.3 (4.1) | 95.7 (4.4) | |
| Physician Visit Group | 95.7 (3.1) | 95.5 (4.2) | |
| Energy (Kilocalories) | | | 0.848 |
| TeleMedicine Group | 1846.0 (257.1) | 1995.7 (425.3) | |
| Physician Visit Group | 1845.2 (460.3) | 1950.1 (548.0) | |
| Fruits & Vegetables (servings) | | | 0.900 |
| TeleMedicine Group | 2.87 (1.83) | 1.63 (1.06) | |
| Physician Visit Group | 2.74 (2.57) | 1.38 (1.19) | |
| Sugary Beverages (servings) | | | 0.798 |
| TeleMedicine Group | 0.61 (0.99) | 0.64 (1.30) | |
| Physician Visit Group | 1.59 (0.67) | 1.83 (1.10) | |
| Junk Food (servings) | | | 0.224 |
| TeleMedicine Group | 0.47 (0.48) | 0.38 (.51) | |
| Physician Visit Group | 0.21 (0.43) | 0.59 (.63) | |
| Physical Activity (METs) | | | 0.974 |
| TeleMedicine Group | 48.3 (35.9) | 72.5 (45.9) | |
| Physician Visit Group | 36.8 (40.5) | 61.9 (32.4) | |
| Sedentary Activity (min/day) | | | 0.381 |
| TeleMedicine Group | 137.7 (102.8) | 102.2 (88.9) | |
| Physician Visit Group | 214.8 (175.0) | 112.1 (89.8) | |

SD, standard deviation, METs, metabolic equivalent tasks.

only had to travel to a room on their medical campus and from there had the ability to serve families all around their state. There was a slight delay between sites which the provider reported they noticed less with time. One hundred per cent of the sessions were carried out as planned with no significant technical problems. One session did start 2 min late due to connection difficulties, but these were easily remedied by re-starting the equipment at the base site.

Regarding 'overall satisfaction' the parents were highly satisfied (M = 8.4, 1.6) and regarding satisfaction with the 'components of the intervention' parents were highly satisfied as well (M = 8.1, 2.0). One hundred per cent of parents reported that the project was helpful, and of note, all parents attended 100% of the sessions.

### Body mass index (BMI) percentile

The mean BMI percentile for children in both groups was 95, indicating that our sample was primarily obese and evenly matched at baseline (TeleMedicine = 95.3, physician visit = 95.7). At post (Table 3, $n = 17$), there was little change in BMI for either group (TeleMedicine = 95.7, physician visit = 95.5, $P = 0.567$). No changes were seen at follow-up.

### Nutrition and exercise behaviours

Regarding caloric consumption, participants in both groups were consuming approximately 1800 kilocalories per day at baseline (TeleMedicine = 1846.0, physician visit = 1845.2). At post, caloric consumption increased for both groups (TeleMedicine = 1995.7, physician visit = 1950.1), but this change was not significant ($P = 0.848$). There were also no significant differences from pre to post for per cent calories from fat ($P = 0.222$), servings of fruits and vegetables ($P = 0.900$), servings of junk food ($P = 0.224$) or servings of sugary beverages ($P = 0.798$). Physical activity increased and sedentary activity decreased for both groups from pre to post although neither was significant ($P = 0.974$, 0.381). At follow-up no change was observed in all nutrition and exercise measures. See Table 3 for more information.

## Discussion

The objective of the current study was to conduct a randomized controlled pilot study assessing the feasibility and satisfaction with TeleMedicine for family-based obesity treatment and also for comparing a TeleMedicine delivered family-based behavioural programme to a primary care visit for improving health among school-age children who are overweight and obese. Data from 17 mother–child pairs who were randomly assigned to either TeleMedicine or Physician Visit conditions indicate that the TeleMedicine intervention was well received and highly feasible and that there were no differences between conditions on major outcome variables.

Data from the current study do indicate, however, that TeleMedicine as a novel intervention technology was extremely feasible and highly satisfactory to participants and to the provider. There were no technological difficulties that interfered with delivery of the intervention services, and the provider reported the technology was easy to use. Families reported they were highly satisfied with the intervention and the technology, and in addition to their self-report of these variables, the 100% attendance rate for all families at all sessions validates this report. When asked what aspects of the intervention they found favourable, parents consistently reported that only having to travel to their child's school for the intervention was very convenient. They reported that they are typically at their child's school almost every day, so having the groups at the school was ideal. Of note, our rural participants were especially enthusiastic about not having to travel to another city or town to receive this type of intervention, something they typically have to do to receive medical or health related care.

Other studies have used TeleMedicine for healthcare intervention. Several have focused on cardiology (Mattioli *et al*. 1992) and other medical issues (Skalet *et al*. 2008). Psychiatry has also used TeleMedicine clinically, with positive results (Modai *et al*. 2006). Previous research has shown that TeleMedicine interventions may improve patient diet, activity levels and weight management, but this research was retrospective in nature, did not contain a control group and did not address patient satisfaction with the TeleMedicine intervention (Shaikh *et al*. 2008).

Paediatric obesity treatment via TeleMedicine seems a natural match for several reasons. First, paediatric obesity treatment is mainly done orally, not requiring specific equipment or close proximity of the patient and family to the health care provider. Second, data indicate that persons who live in rural areas are underserved in all facets of health care, including obesity treatment (Tai-Seale & Chandler 2003) and TeleMedicine allows providers to meet this clinical need without the cost in time and transportation to travel to these patients. Finally, TeleMedicine allows the paediatric obesity treatment programmes that do exist to reach more patients who may have difficulty travelling to their programmes through the use of technology. Current literature suggests that, in order to meet the rising health demands of our public, health care providers should increase their use of TeleMedicine and other such eHealth options (Strecher 2008).

Clearly, the four-session TeleMedicine intervention did not have the desired clinical impact. Review of successful paediatric obesity interventions indicates that most interventions are three to 6 months in length (Epstein *et al*. 2007) with weekly meetings, suggesting our intervention was not nearly powerful enough. In fact, the newest guidelines suggest that 25 h of face-to-face contact over a 6 month period is the minimum intervention contact recommended for effectiveness regarding paediatric obesity interventions (Whitlock *et al*. 2010). Therefore, we have revised our intervention and are currently piloting an 8-month intervention via TeleMedicine which shows some promise. Also, our sample size in the current study was extremely small (necessitated by our funding mechanism), which decreases the meaning and impact of our findings.

Future research should include the expansion of the study of TeleMedicine into not only the area of paediatric obesity but also into other areas of paediatric psychology. Our own ongoing research will assess the impact of an improved paediatric obesity intervention being delivered by TeleMedicine, but we plan to expand our programme to other eHealth delivery mechanisms, including the Internet, CD-ROM or

handheld computers. Without the assistance of these technologies, it will be difficult for the field of paediatric psychology to keep pace with the increasing clinical demand for services.

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## Conflicts of interest

The authors declare that they have no conflicts of interest.

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